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1 **ABSTRACT**

2 In this study, we report field, microstructural and geochronological evidence for localized
3 and dynamically evolving fluid flux associated with the syntectonic intrusion of the
4 Caçapava do Sul Granitic Complex into the dolomitic marbles of the Passo Feio
5 Metamorphic Complex (Dom Feliciano Belt, southern Brazil). The marbles were intruded
6 by mafic intrusions between 600 and 580 Ma followed by felsic intrusions from 578 to 557
7 Ma, triggering a set of metasomatic reactions in the host and intrusive rocks. Skarns and
8 hydrothermal veins were formed at different stages of pluton assembly and represent
9 useful indicators of the pathways used by the magmatic fluids when infiltrating the
10 dolomitic marbles.

11 The first metasomatic stage resulted in the formation of diopside and forsterite skarns from
12 fluids released from felsic apophyses. Fluid pathways, recorded by reaction textures of the
13 skarns, were highly localized along pre-existing areas of high permeability such as
14 lithological boundaries, foliation planes as well as in fold hinges and axial planes. Fluid flux
15 in this first stage must have occurred at high temperatures (590 to 630°C) in which the
16 changes of the skarn assemblages were controlled by either variable fluid fluxes or
17 constant flux and variable chemical properties of the fluid phase (e.g., silica activity,
18 X_{CO_2}). Zircon U-Pb age of c. 578 Ma obtained for a felsic apophysis directly associated to
19 forsterite skarns defines the age of the first metasomatic stage.

20 The second metasomatic stage is mainly characterized by serpentization of previous
21 skarn silicate assemblages, chloritization of mafic and felsic apophyses and formation of
22 calcite-chlorite-sulfide veins and breccias at ~300°C. The fluid flow regime at this stage
23 was controlled by the porosity and permeability created by fracturing related to the cooling
24 of the granitic complex. Metasomatic apatite and titanite from mafic apophyses record
25 consistent U-Pb ages of c. 557 Ma that mark the second metasomatic stage associated
26 with the thermal resetting effect caused by late felsic intrusions and subsequent cooling of

27 the Caçapava do Sul Granitic Complex. The intrusive record of the magmatic complex
28 lasts for at least 21 My.

29 Our study shows that metasomatic reactions commonly observed in the host rocks and
30 apophyses of a magmatic complex provide useful insights on timing of the pluton
31 assembly, deformation and associated fluid activity.

32

33 **Keywords:** fluid-rock interaction, skarn, localized fluid flow, syntectonic magmatism,
34 metasomatism